(12) UK Patent Application (19) GB (11) 2 363 295 (13) A

(43) Date of A Publication 12.12.2001

(21) Application No 0028437.2

(22) Date of Filing 22.11.2000

(30) Priority Data
(31) 09447632 (32) 23.11.1999 (33) US

(71) Applicant(s)
International Business Machines Corporation
(Incorporated in USA - New York)
Armonk, New York 10504, United States of America

(72) Inventor(s)
Jose R Brunheroto
Frans Laemen
Julio Nogima
Frank Andre Schaffa
William J Anzick

(74) Agent and/or Address for Service
M J Jennings
IBM United Kingdom Limited, Intellectual Property Department, Hursley Park, WINCHESTER, Hampshire, SO21 2JN, United Kingdom

(51) INT CL[7]
H04J 3/24

(52) UK CL (Edition S)
H4M MTX1

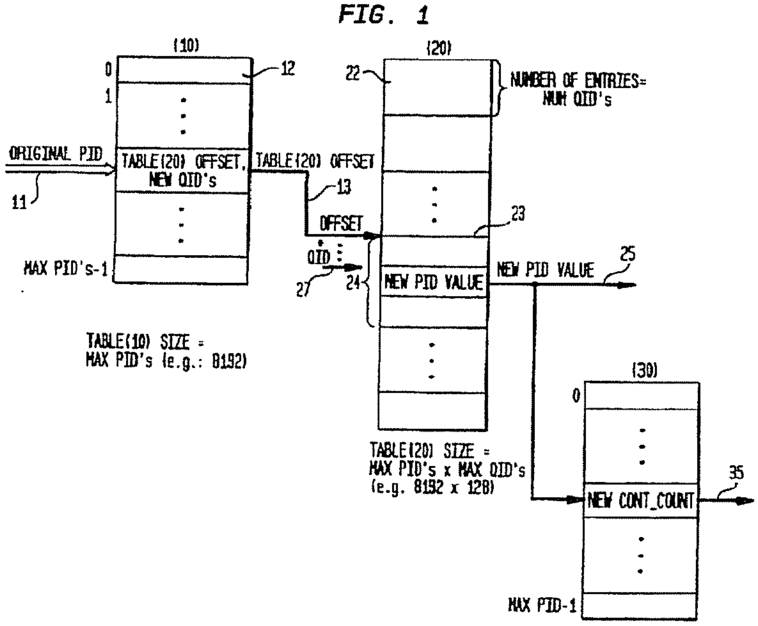
(56) Documents Cited
WO 98/47284 A1 US 5838873 A

(58) Field of Search
UK CL (Edition S) H4M MTX1 MTX2 MTX3
INT CL[7] H04J 3/24, H04N 7/50
On-Line - EPODOC, INSPEC, JAPIO, WPI

(54) Abstract Title
Multiplexing programs into a single transport stream without PID conflicts

(57) In order to avoid Packet Identifier (PID) conflicts in multiplexed MPEG-2 program streams, the PID's are re-mapped, in real-time, with unique values, by use of look-up tables. In operation, each program stream transport packet contains a PID value and each program stream has an associated stream identifier (eg queue ID, QID). The PID 11 is used to index a first table 10 for generating an offset value 13. The offset value is then used to address a region 22 of a second table which contains a plurality of new PID values capable of being mapped to the original PID value. The stream identifier (QID) is used to index this region to provide the new PID value 25 which is subsequently exchanged for the original PID.

FIG. 1



GB 2 363 295 A

FIG. 1

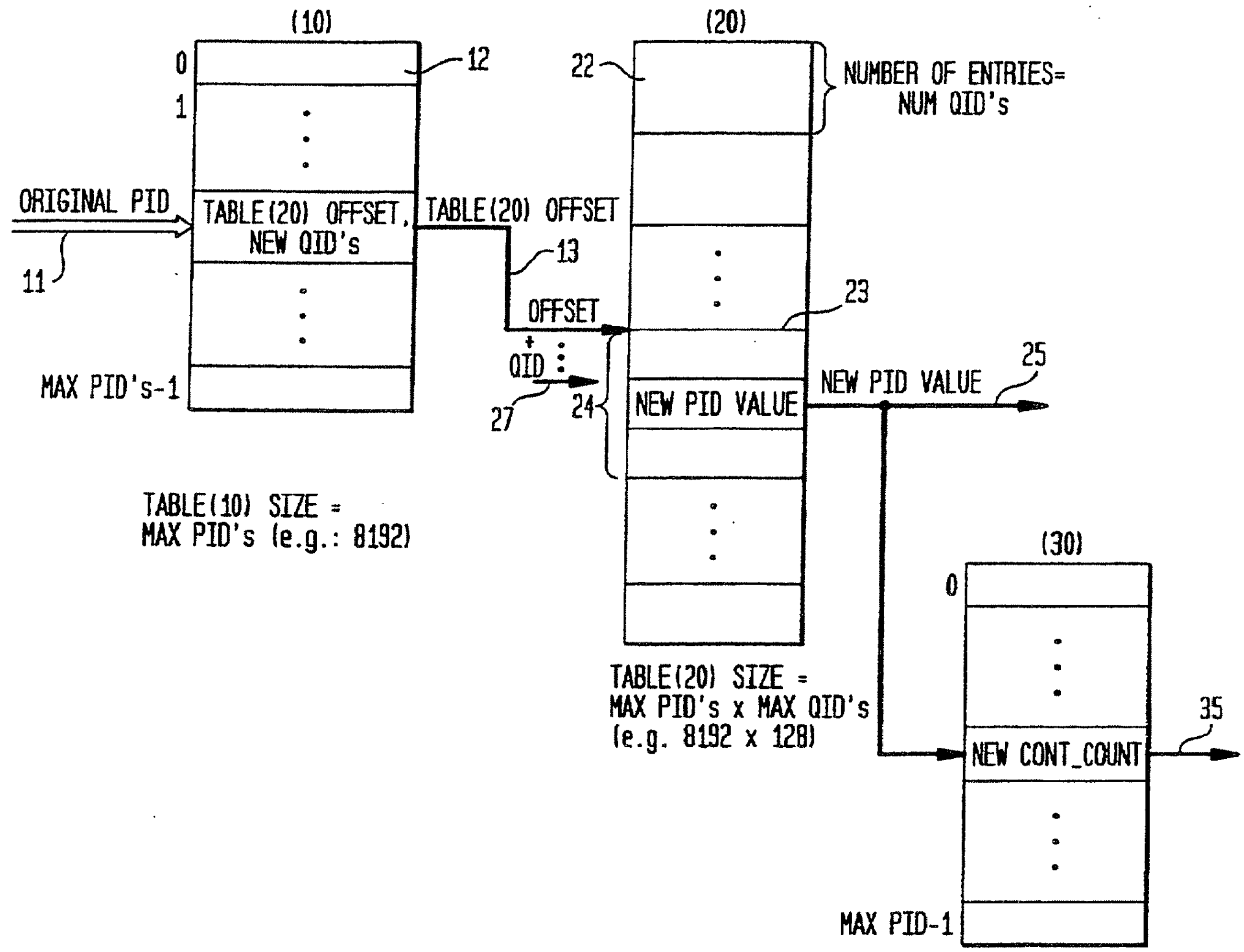

(10)
0
1
12
ORIGINAL PID
11
TABLE(20) OFFSET, NEW QID's
TABLE(20) OFFSET
13
MAX PID's-1
TABLE(10) SIZE = MAX PID's (e.g.: 8192)
(20)
22
NUMBER OF ENTRIES= NUM QID's
23
OFFSET
+
QID
27
24
NEW PID VALUE
NEW PID VALUE
25
TABLE(20) SIZE = MAX PID's x MAX QID's (e.g. 8192 x 128)
(30)
0
NEW CONT_COUNT
35
MAX PID-1

FIG. 2(a)

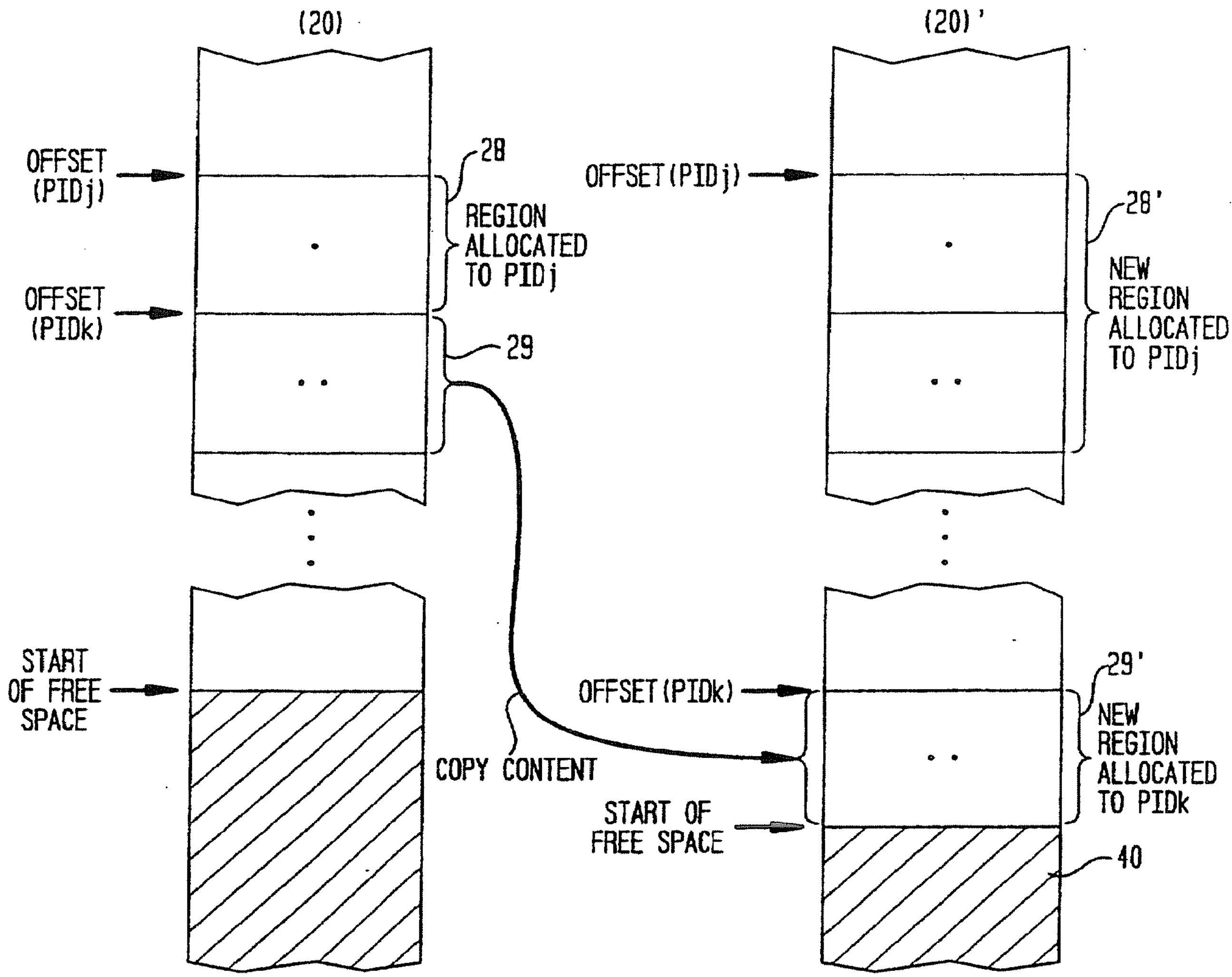

(20)
(20)'
OFFSET (PIDj)
28
REGION ALLOCATED TO PIDj
OFFSET (PIDk)
29
START OF FREE SPACE
COPY CONTENT
OFFSET(PIDj)
28'
NEW REGION ALLOCATED TO PIDj
OFFSET(PIDk)
29'
NEW REGION ALLOCATED TO PIDk
START OF FREE SPACE
40

FIG. 2(b)

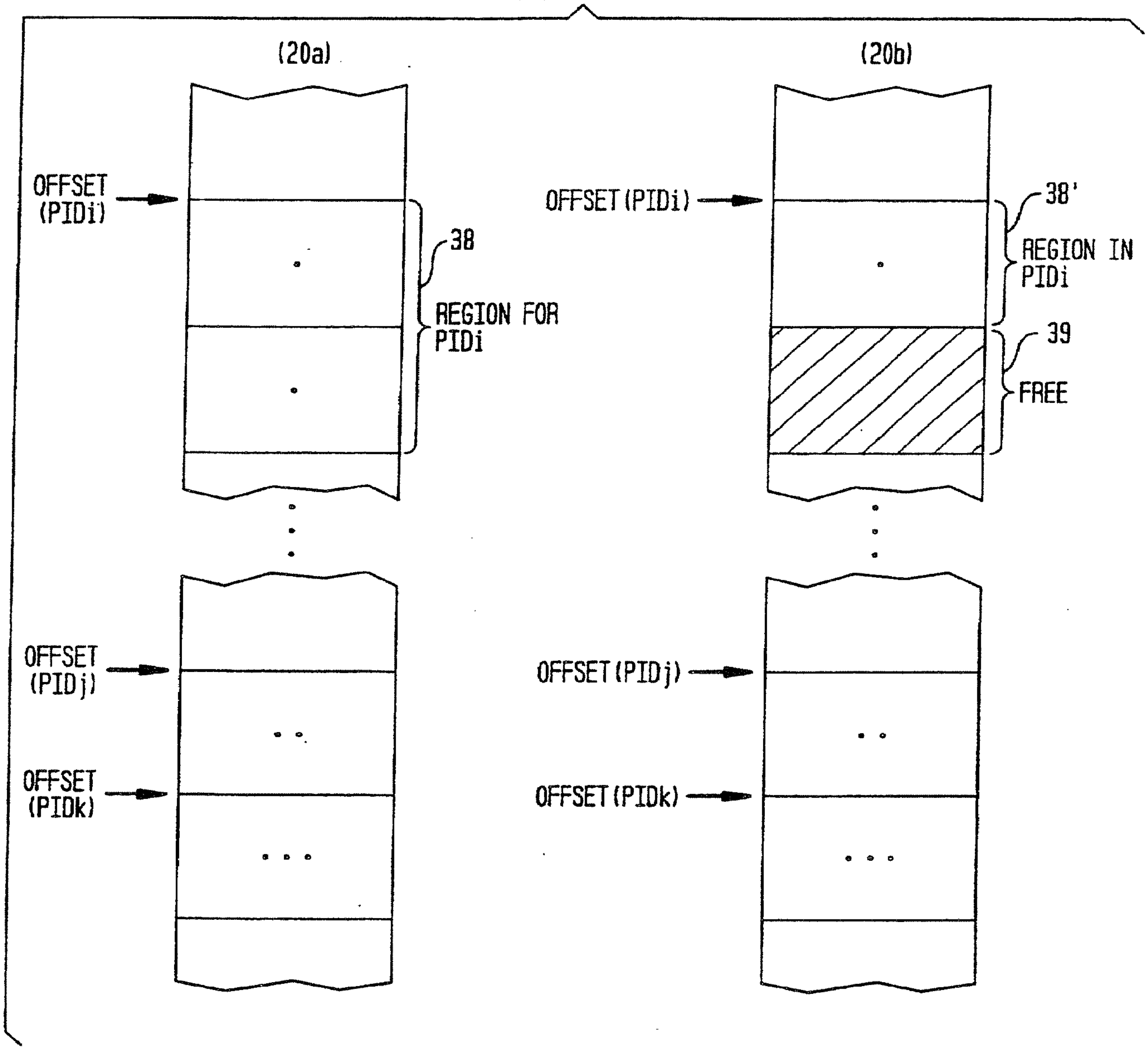
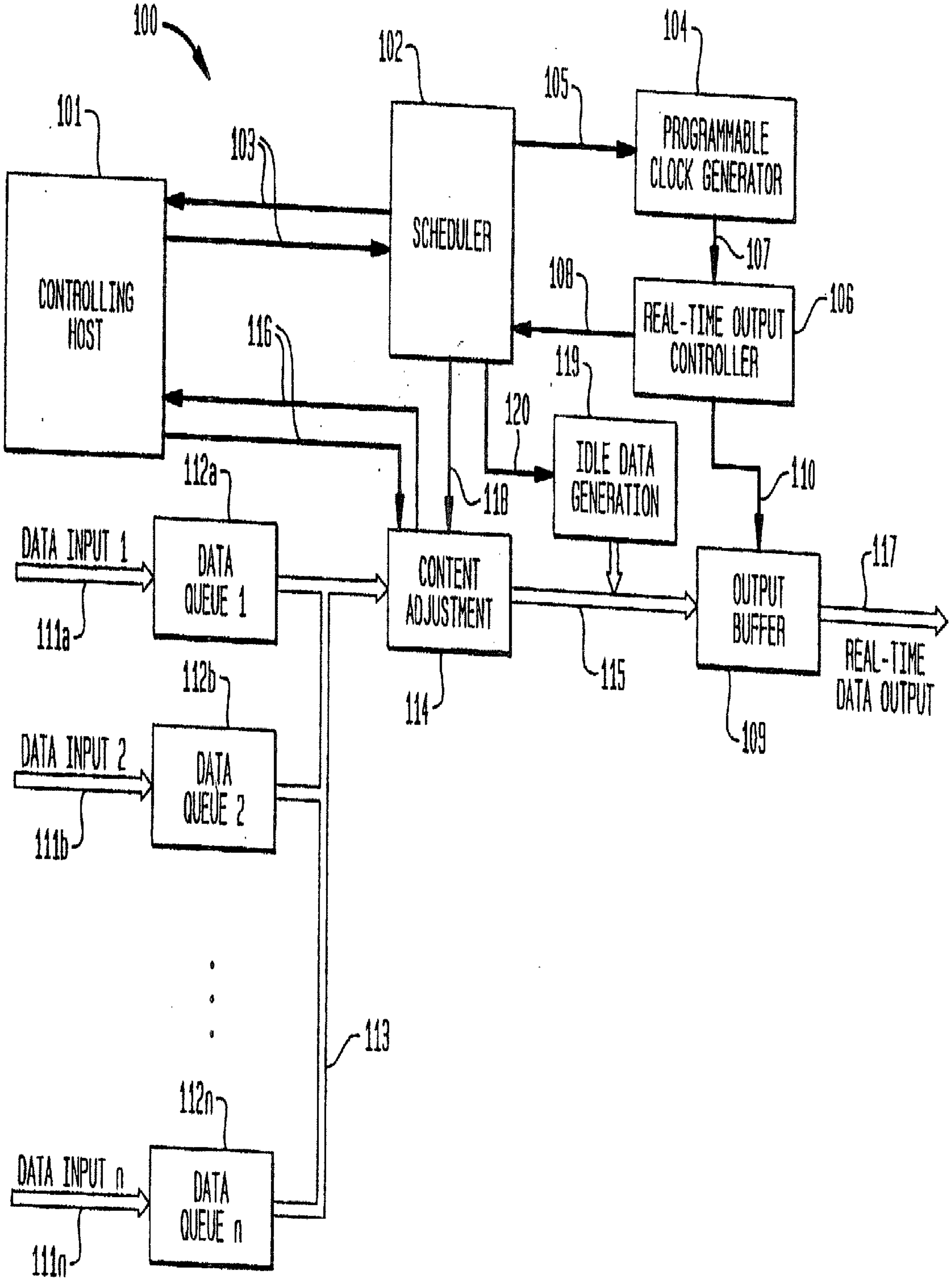

(20a)
(20b)
OFFSET (PIDi)
38
REGION FOR PIDi
OFFSET(PIDi)
38'
REGION IN PIDi
39
FREE
OFFSET (PIDj)
OFFSET (PIDk)
OFFSET(PIDj)
OFFSET(PIDk)

FIG. 3


100
101
CONTROLLING HOST
102
SCHEDULER
103
104
PROGRAMMABLE CLOCK GENERATOR
105
106
REAL-TIME OUTPUT CONTROLLER
107
108
109
OUTPUT BUFFER
110
111a
111b
111n
112a
112b
112n
113
114
CONTENT ADJUSTMENT
115
116
117
118
119
IDLE DATA GENERATION
120
DATA INPUT 1
DATA QUEUE 1
DATA INPUT 2
DATA QUEUE 2
DATA INPUT n
DATA QUEUE n
REAL-TIME DATA OUTPUT

METHOD AND APPARATUS FOR MULTIPLEXING SEVERAL PROGRAMS INTO A SINGLE TRANSPORT STREAM

The present invention relates to multiplexing several programs into a single transport stream.

The MPEG-2 Generic Coding of Moving Pictures and Associated Audio: Systems Recommendation H.222.0 ISO/IEC 13818-1 defines the mechanisms for combining, or multiplexing, several types of multimedia information into one program stream. This standard uses a known method of multiplexing, called packet multiplexing. With packet multiplexing, elementary streams comprising data, video, audio, etc. are interleaved one after the other into a single MPEG-2 stream.

Transport Streams (TSs) are defined for transmission networks that may suffer from occasional transmission errors. The Packetized Elementary Streams (PESs) are further packetized into shorter TS packets of fixed length, e.g., 188 bytes. A major distinction between TS and PES is that the TS can carry several programs. Each TS packet consists of a TS Header, followed optionally by ancillary data called Adaption Field, followed typically by some or all the data from one PES packet. The TS Header consists of a sync byte (0x47), flags, indicators, Packet Identifier (PID), and other information for error detection, timing, etc. According to the MPEG-2 standard, the semantics for the TS include the following:

Sync_byte: (8-bits) a fixed value 0x47;

Transport_error_indicator: (1-bit) for indicating that an uncorrectable bit error exists in the current TS packet;

Payload_unit_start_indicator: (1-bit) for indicating the presence of a new PES packet or a new TS-PSI (program specific information) Section;

Transport_priority: (1-bit) for indicating a higher priority than other packets;

PID: 13-bit packets Ids including values 0 and 1 which are pre-assigned, while values 2 to 15 are reserved. Values 0x0010 to 0x1FFE, may be assigned by the Program Specific Information (PSI) and value 0x1FFF is used to identify MPEG-2 Null packets;

Transport_scrambling_control: (2-bits) for indicating the scrambling mode of the packet payload;

Adaptation_field_control: (2-bits) for indicating the presence of an optional adaptation field prior to the payload;

Continuity_counter: which is a counter provided per PID (e.g., 4-bits) that increments with each non-repeated TS packet having the corresponding PID.

Each MPEG-2 program stream may be characterized as a data stream (which can contain data originated from a multitude of data sources) encapsulated using MPEG-2 TS packets, with each packet containing a header field with a Packet Identifier (PID). The PID field is used by the transport demultiplexer to "tune" to a particular set of PID's that correspond to a given program stream. Each program stream must have a set of distinct PID's (except for PID = 0x1FFF for the MPEG-2 Null packet).

As an example:

Program Stream 1:<video PID = 0x101, audio PID = 0x102, secondary audio PID = 0x107, 0x1FFF> valid

Program Stream 2:<video PID = 0x101, audio PID = 0x200, private data PID = 0x107, 0x1FFF> valid

Program Stream 3:<video PID = 0x102, audio PID = 0x102, 0x109> invalid (audio and video programs are sharing same PID = 0x102).

As an MPEG-2 transport stream multiplexes several program streams into one single transport, in order to avoid ambiguity at the receiver, it is required that all the PID's belonging to the transport stream be distinct. Thus, given a set of program streams that need to be multiplexed into a single transport stream, all the PID's must be distinct (except for the Null packet which can be present in any program stream). In the above example, the PID = 0x101 is used for (video programs 1 and 2) is not allowed since it will lead to a conflict error. Therefore, in the example, one of the programs has to reassign a new PID value to all packets containing PID = 0x101 in order to remove the conflict.

One way to eliminate the PID conflict is a static technique implemented at program stream creation time, which requires the encoder to ensure distinction for all the PID's for all the program to be multiplexed into a single transport stream. This requires the content provider to encode all material (e.g., movies, documentaries, sports events, news, etc.) with full knowledge of the playing sequence, to avoid PID conflict among the sources which is very restricting. Typically, this playing

sequence is not known at encoding time making the static re-mapping scheme virtually infeasible.

Another possibility for eliminating the PID conflict is to search all the PID's for all the program streams that are being multiplexed. If a PID value appears in more than one program stream, then a new value is chosen that is not being used by any of the program streams. However, this process is time consuming and non-efficient because for each PID it is necessary to check all others to see if it is used by another program, the process has to be repeated for all the PID's for all the programs.

Accordingly, the invention provides a method for re-mapping packet identifier (PID) values provided in transport packets associated with different program streams to be multiplexed onto a single shared transport channel, each program stream having an associated identifier value, said method including: utilizing original PID value associated with packet to index a first table for generating an offset value; addressing a region of a second table using said offset value, said second table providing a plurality of new PID values capable of being mapped to said original PID value; utilizing said identifier value associated with said program stream to provide an index into said region to provide said new PID value; and exchanging said original PID with said new PID value in said transport packet.

According to another aspect, the invention provides a system for re-mapping packet identifier (PID) values provided in transport packets associated with different program streams to be multiplexed onto a single shared transport channel, each program stream having an associated identifier value, said system including: means for indexing a first look-up table for generating an offset value relating to an original PID value associated with the packet to be multiplexed; means implementing said offset value for identifying a start address in a second look-up table including a region having a plurality of new PID values capable of being mapped to said original PID value; means utilizing said identifier value associated with the transport stream of said packet as an index into said region to generate a new PID value; and means for exchanging said new PID value with said original PID value included in said transport packet.

Systems and methods for multiplexing packet streams on a shared transport channel are preferably provided, and, more particularly, a method for ensuring unique identification of packets associated with one or more

program streams to be multiplexed on an single transport channel is preferably provided.

According to a preferred embodiment a very efficient PID re-mapping mechanism for eliminating the PID conflict in the multiplexed transport stream is provided, and moreover, one that is implementable in hardware so the PID re-mapping can be done in real-time.

Preferably, a dynamic technique for distinctly assigning numbers to packets belonging to a plurality of program streams to be multiplexed on a transport channel, while avoiding searching of all the PID's for all the program streams is provided.

Further preferably, a real-time processing mechanism for dynamically re-mapping PIDs to eliminate the PID conflict in the multiplexed transport stream imposing no limitation on the PID assignment at the encoding time is provided.

The PID re-mapping scheme of the preferred embodiment is very efficient and straight forward to implement, using a look-up table (SRAM) and limited hardware assist (for real-time support). The PID re-mapping scheme additionally implements a mechanism for dynamically increasing or decreasing the size of a given PID re- mapping region. Furthermore, besides performing a transport stream PID re-mapping capability, the apparatus and method is also preferably capable of modifying the MPEG-2 TS continuity_counter field -which capability is important for: 1) applications that switch between different program streams while maintaining the continuity of the continuity_count; and, 2) other content alteration schemes that require prevention of continuity content "jumps".

A preferred embodiment of the present invention will now be described, by way of example only, with reference to the following drawings:

Figure 1 is a block diagram illustrating the PID re-mapping technique using two-stage direct mapped lookup table according to a preferred embodiment.

Figure 2(a) illustrates the mechanism used to dynamically increase the size of a given PID re-mapping region according to one embodiment.

Figure 2(b) illustrates the mechanism used to dynamically decrease the size of a given PID re-mapping region according to one embodiment.

Figure 3 is a block diagram illustrating conceptually an MPEG-2 time division multiplexing system incorporating the PID re- mapping scheme of a preferred embodiment of the present invention.

According to a preferred embodiment of the present invention, as shown in Figure 1, the PID re- mapping implements a two-stage table look-up scheme using look-up "swap" tables (10), (20) comprising SRAM's, for example, and an MPEG-2 PID re-mapping engine implemented using Field Programmable Gate Arrays (FPGAs), as will be described in greater detail herein. The first table (10) is provided which consists of a plurality of entries corresponding to the number of PIDs per transport stream (e.g., one entry for each PID). In case of MPEG-2 TS, PID re-mapping, given that the MPEG-2 PID field contains 13-bits, there are at most 8,192 possible PID entries in table (10) corresponding to the possible number of PID values. As shown in Figure 1, the table (10) is implemented for only one transport stream, but it is understood that the scheme may be used for multiple transport streams by replicating the table (10) for each additional transport stream.

As shown in Figure 1, the original PID value (11) is used to address the first table (10). For each entry (12) in the first table (10), a correspondent region (22) is assigned in a second swap table (20) which provides the new PID value. The size of correspondent region 22 depends on the maximum number of programs that are multiplexed in one transport stream. Each program has an associated stream identifier referred to herein as a queue ID (QID), the function of which is shown and described in greater detail in commonly-owned, co-pending U.S. Patent Application No. 09/448334 (YO999-394, D#12949) entitled METHOD AND APPARATUS FOR MULTIPLEXING A MULTITUDE OF SEPARATE DATA STREAMS INTO ONE SHARED DATA CHANNEL, WHILE MAINTAINING CBR REQUIREMENTS the whole contents and disclosure of which is incorporated by reference as if fully set forth herein. A copy has been placed on the file. Thus, for example, if the maximum number of programs is 128, then each region (22) contains 128 entries corresponding to 128 QIDs. Note, that in one embodiment, a direct mapping is used to generate the address to the second table (20), and the number of entries per region (22) is constant, e.g., and is a power of 2. In a preferred embodiment, however, the size of a region (22) may be dynamically expanded to accommodate increased programs per transport stream

or decreased to accommodate a decrease in the number of programs per transport stream. Thus for instance, the system enables the amount of new PID values to be dynamically increased for a given region (22) as new program streams are to be multiplexed onto said shared transport channel. Alternately, or in addition to, as shown in Figure 2(a), the system dynamically reassigns new table regions in the second table 20 associated with an original PID value as new program streams are to be multiplexed onto said shared transport channel. For instance, as shown in Figure 2(a), table (20) indicates a first region (28) of new PID values corresponding to a PID value "PIDj" pointed to by offset value PIDj. As memory space of table (20) is expandable to define corresponding table (20) there is illustrated an increased region (28') of new PID values allocated for the offset value PIDj as new program streams are provided. Likewise, table (20) indicates a first region 29 of new PID values corresponding to a PID value "PIDk" pointed to by offset value PIDk. As shown in expanded table (20'), contents of the region (29) may be copied to a new region (29') allocated for the PID value PIDk which is adjacent free memory space area (40) for further expansion as the number of QIDs per stream grow.

As mentioned, the region size (for a given PID) is determined by the largest QID number associated to it. Thus, assuming an example initial set maximum number of QID's as 32 (5-bits), then if additional QID's are added in the MPEG-2 Transport Stream, eventually the maximum number of QID's reaches 33. At this moment, the region size for the PID's that belong to the (QID == 33) is doubled, as a region with 64 entries (needs6-bits) is now preferable. Figure 2(b) illustrates the mechanism used to dynamically decrease the size of a given region. Figure 2(b) illustrates an example second swap table (20a) indicating this new PID as PIDi having an increased corresponding region 38 of new PID values. Assuming that no more QID's are added, and the (QID == 33) is subsequently removed from the MPEG-2 Transport Stream, then the region associated with PIDi preferably needs only 32 entries. Thus, as shown in the resultant second swap table (20b), the size of increased region 38 associated with PIDi is decreased by half 38', i.e., resulting in a "free" remainder half 39 that may be used by another PID that gets assigned.

In operation, as shown in Figure 1, each entry in table (10) per PID input is an offset value (13) that points to the start (23) of a region (24) comprising values for re-mapping a given PID. The current QID (stream identifier) value (27) for the program associated with that transport packet to be multiplexed, is added to the offset value (13) for addressing

table (20) to obtain the new PID value (25). That is, for each transport packet being multiplexed, the hardware assist indicates the correspondent program stream identifier (QID), which number is concatenated with the offset output of the first table (10) to generate the address for the second table (20). The output of the second table (20) is the new PID value that is used to replace the original PID value.

As further shown in Figure 1, the system of the preferred embodiment includes a further mechanism for generating a new continuity_count value to be swapped with the original continuity_count value contained in the header of the original transport packet to be multiplexed. The new PID value (25) is used to address a continuity_count table (30) comprising the modified continuity_count values, for generating an appropriate continuity_count value (35) which is exchanged with the original continuity_count value of the multiplexed transport packet. The new continuity_count value (35) is stored in the packet header of the transport packet prior to multiplexing and is used to ensure continuity of the multiplexed stream, for instance, in the case where a program such as an advertisement is to be inserted (spliced) into the program stream or other alterations on the content required updates, due to changed, inserted or removed TS packets.

A further feature (not shown) is the provision of a non-real time process for parsing the transport stream's Program Specific Information "PSI" tables, extracting PID's for each program, and generating the appropriate contents for the swap tables (10) and (20). It is understood that lists must be kept of all the PID's that are being used by all the program streams for a given transport stream, the region sizes used in the second table, and the new PID values. Thus, when a program stream is added to the transport stream, each of its original PID's is checked against the list of the new PID's in use. If the PID is in use, the corresponding usage count is incremented, an offset value (13) is assigned to the PID, and a new PID is created and written to the second swap table (20). If the PID has not been used yet, the next unused offset value (region) is assigned, and a new PID is created and written to the second table (20). Furthermore, when a program stream is removed from the multiplexed transport stream, each of its original PID's is removed from the lists. The new PID's associated with this program stream are marked as unused, and the usage count is decremented. When the usage count reaches zero, both the PID and the associated region are marked as unused and, therefore, become available for subsequent use.

Figure 3 illustrates conceptually a real-time multiplexing system (100) incorporating the PID re-mapping engine of a preferred embodiment of the present invention. Particularly, Figure 3 is a functional block diagram depicting the preferred implementation of a transport stream multiplexer such as described in above-referenced, co-pending U.S. Patent Application No. 09/448334 (YO999-394, D#12949). The real-time multiplexing system (100) provides multiplexed data content from a variety of sources for transmission output over a transport channel (117) having an associated Channel Bit Rate (ChBR). As shown in Figure 3, data streams from a plurality of data sources (not shown) are segmented into fixed length packets and transported from separate Data Sources (not shown) over respective Data Input connections (111a),..,(111n) to respective assigned Data Queues labeled (112a),..,(112n) provided in a packet memory (not shown). Each packet is a Fixed Packet Size (FPS), e.g., 188 bytes, in accordance with the MPEG-2 Transport Stream protocol. Further, all data sources providing a data stream are dynamically assigned a unique QID upon initialization, and, are thereafter identified thereby. As shown in Figure 3, for each Data Input (111a),..,(111n) connection there is provided a corresponding dedicated bus, however, a shared data bus structure (113) may be implemented.

Although not shown in Figure 3, hardware including a real-time DMA Controller and a small Fast Access (FIFO) Buffer large enough to hold at least one transport packet is connected to the Shared Data Bus (113). In operation, upon request from a Scheduler device (102) via control lines to the DMA controller and fast access (FIFO) buffer (not shown), transfer of a transport packet from a Data Queue (112) is initiated by the scheduled QID to the FIFO Buffer via a bus (113). Note that the only functionality of the DMA controller and FIFO Buffer according to the preferred embodiment is to ensure real-time access to the next scheduled packet. As further shown in Figure 3, there is provided a data path to a second buffer referred to as the Output Buffer (109), which, preferably, is large enough to hold several transport packets for multiplexed output thereof over real-time transport channel (117).

Figure 3 further illustrates the Real-Time Output Controller (106) which provides a signal (110) to enable the Output Buffer (109) to transmit the appropriate amount of data in the appropriate time, depending upon the physical layer characteristics of the single transport channel. The Real-Time Output Controller (106) operates under timing derived from a Clock Signal (107) received from the Programmable Clock Generator (104)

which is preset by the Scheduler (102) via signal line (105). As shown in Figure 3, the scheduler (102) receives the ChBR information upon channel initialization from a controlling host (101) through a host interface (103).

In the preferred embodiment, data content from data queues (112) is provided to the Output Buffer (109) from the Fast Access Buffer via the intermediary of a content adjuster block (114) which implements changes to the Transport Packets as required by the TDM. It is in the content adjuster block (114) that the PID re-mapping scheme according to a preferred embodiment of the present invention, is provided. As mentioned, after completion of the transfer of packet from the appropriate Data Queue (112) into the FIFO Buffer upon request from the Scheduler (102), the PID real-time engine in the Content Adjustment block (114) reads, adjusts and moves the total packet from the FIFO Buffer to the Output Buffer (109). The Real-Time Output Controller (106) informs the scheduler (102) of the completion of the transmission of every Transport Packet which enables the Scheduler (102) to remain synchronized with the ChBR and keep accurate timing information via signal line (108).

According to the preferred embodiment, as shown in Figure 3, the content adjuster block includes an MPEG-2 transport stream (TS) PID re-mapping engine having the characteristics and capabilities described herein including: 1) capability of performing on-the- fly PID re-mapping for a given set of program streams multiplexed into one transport stream. Note: the maximum number of program streams per transport stream defines the swap table SRAM size; and 2) capability of re-establishing the continuity (of TS header continuity_count) when switching from one program stream to another (e.g., movie->advertisement->movie). Preferably, the task of computing new offsets and new PID for the tables (10) and (20) is done prior to inserting the program stream into the transport stream, and requires minimum support from the host processor (101). Particularly, hardware is provided to actually fetch the PID, and read both tables (10), (20) to get the new PID value and replace the old PID with the new PID in the TS packet.

Further capabilities include: capability of detecting non- assigned PID's for a given program stream, and replacing them with MPEG-2 Null packets, thus, avoiding undesired data to be transmitted. For example, filtering out packets based on the contents of PSI table; capability of removing a given packet from a program stream, and replacing it with an

MPEG-2 Null packet which is useful if bandwidth has to be reserved to transmit data embedded in the program stream; capability of detecting TS continuity_count jumps, indicating possible packet loss, and signaling it to the host processor; and, capability of reporting packets that contain an adaptation field (e.g., PCR).

In an example implementation, the real-time MPEG-2 PID re-mapping engine supports up to 128 program streams per transport stream, and furthermore, it supports up to two multiplexed transport program streams ports. Access to the two- stage look-up table can be done by the host processor (capable of altering its contents) (101) and by the re-mapping engine (read only). A synchronization mechanism is used that gives priority to the real-time engine.

The Fast Access Buffer (FIFO) used to interface the real-time engine provided in the content adjuster (114) with the packet memory, receives data from the packet memory a packet at a time. The real-time engine initially reads the packet header (PID) and starts the process of PID re-mapping, with the new PID value replacing the original PID value. The remainder of the packet is then transmitted to the output buffer (109). Note: when programing the DMA controller engine to transfer one packet from the Packet memory to the Fast Access Buffer (FIFO), the host processor also programs the real-time engine, indicating which program stream (QID) is associated to this packet. This real- time PID re-mapping engine additionally checks if a packet belonging to a given program stream contains a PID that is not present in the look-up table. In such a scenario, the real-time engine replaces the packet (header + payload) with an MPEG-2 Null packet, and optionally signals the host processor (101) indicating an error condition. Furthermore, the engine is capable of removing a given packet and replacing it with an MPEG- 2 Null packet (as directed by the Host Processor). This operation is useful if the multiplexer is reserving bandwidth for in-band data transmission using the program stream. Additionally, the real-time engine may report the presence of packets that includes an adaptation field which is useful to help identify packets that carry the Program Clock Reference (PCR) information.

CLAIMS

1. A method for re-mapping packet identifier (PID) values provided in transport packets associated with different program streams to be multiplexed onto a single shared transport channel, each program stream having an associated identifier value, said method including:

utilizing original PID value associated with packet to index a first table for generating an offset value;

addressing a region of a second table using said offset value, said second table providing a plurality of new PID values capable of being mapped to said original PID value;

utilizing said identifier value associated with said program stream to provide an index into said region to provide said new PID value; and

exchanging said original PID with said new PID value in said transport packet.

2. The method as claimed in Claim 1, wherein each packet comprises a packet header and said packet header includes continuity_count value for ensuring continuous stream of packets for multiplexing, said method further comprising the step of regenerating a continuity_count value based on said new PID value to ensure continuity of said transport stream for that program.

3. The method as claimed in Claim 2, wherein said regenerating step further includes the step of utilizing said new PID value to address a third table for generating continuity_count values.

4. The method as claimed in Claim 1, 2 or 3, wherein each said region associated with an original PID includes a pre-determined amount of new PID values.

5. The method as claimed in Claim 4, further including the step of dynamically increasing an amount of new PID values for a given region as new program streams are to be multiplexed onto said shared transport channel.

6. The method as claimed in Claim 4 or 5, further including the step of reassigning new table regions in said second table associated with an original PID value as new program streams are to be multiplexed onto said shared transport channel.

7. The method as claimed in Claim 4, 5 or 6, further including the step of dynamically decreasing an amount of new PID values for a given region as a program stream is removed from said shared transport channel.

8. A system for re-mapping packet identifier (PID) values provided in transport packets associated with different program streams to be multiplexed onto a single shared transport channel, each program stream having an associated identifier value, said system including:

means for indexing a first look-up table for generating an offset value relating to an original PID value associated with the packet to be multiplexed;

means implementing said offset value for identifying a start address in a second look-up table including a region having a plurality of new PID values capable of being mapped to said original PID value;

means utilizing said identifier value associated with the transport stream of said packet as an index into said region to generate a new PID value; and,

means for exchanging said new PID value with said original PID value included in said transport packet.

9. The system as claimed in Claim 8, wherein each packet comprises and packet header, said packet header includes continuity_count value for ensuring continuous stream of packets for multiplexing, said system further including means for regenerating a continuity_count value based on said new PID value to ensure continuity of said transport stream for that program.

10. The system as claimed in Claim 9, wherein said regenerating means includes means utilizing said new PID value for addressing a third table for generating a continuity_count value.

11. The system as claimed in Claim 8, 9 or 10, wherein each said region associated with an original PID includes a pre-determined amount of new PID values.

12. The system as claimed in Claim 8, 9, 10 or 11, further including means for dynamically increasing an amount of new PID values for a given region as new program streams are to be multiplexed onto said shared transport channel.

13. The system as claimed in any of Claims 8 to 12, further including means for reassigning new table regions in said second table associated with an original PID value as new program streams are to be multiplexed onto said shared transport channel.

14. The system as claimed in any of Claims 8 to 13, further including means for dynamically decreasing an amount of new PID values for a given region as a program stream is removed from said shared transport channel.

15. A system for multiplexing transport packets associated with one or more data sources for transmission over a shared fixed bit rate medium wherein the multiplexing system includes: a data queue memory storage device associated with a respective data source for storing transport packets associated with said data source, each data queue memory device having an associated queue identifier (QID) and each transport packet having a header including an associated packet identifier (PID); an output buffer for multiplexing said packet onto said shared fixed bit rate medium; and, a data bus connecting said data queue memory storage device with said output buffer; a real-time PID re-mapping system comprising:

buffer means for receiving said transport packet from a data queue memory device from said data bus;

the first and second look-up table and the utilizing means and exchanging means of any of claims 8 to 14, wherein the new PID value is generated as an output of the second table, and said original PID value is included in the transport packet header.

The Patent Office

INVESTOR IN PEOPLE

14

Application No: GB 0028437.2
Claims searched: 1 to 15

Examiner: Jared Stokes
Date of search: 3 October 2001

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.S): H4M (MTX1, MTX2, MTX3)

Int Cl (Ed.7): H04J (3/24)
H04N (7/50)

Other: On-Line - EPODOC, INSPEC, JAPIO, WPI

Documents considered to be relevant:

Category	Identity of document and relevant passage	Relevant to claims
A	WO 98/47284 A1 (Thomson) See page 24 lines 25-33	-
A	US 5 838 873 (Blatter et al.) See abstract	-

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.